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(54) [Title of the Invention] DEVELOPING APPARATUS AND IMAGE FORMING APPARATUS HAVING SUCH DEVELOPING APPARATUS

(57) [Abstract]

[Object] The present invention provides a developing apparatus which permits application of a stable developing processing by supplying sufficient "tribo" to a developing agent on a developing agent carrier even when the developing agent of the developing apparatus is consumed rapidly, and an image forming apparatus having such a developing apparatus.

[Solving Means] The developing apparatus of the present invention has a configuration in which toner on a developing sleeve 4a is fictionally charged by the rotation of a developing sleeve 4a, and is set so that the developing sleeve 4a is subjected to developing processing after rotational driving for a predetermined

rotational driving period. The developing apparatus comprises a dot counter 101 for measuring the amount of image information, and a CPU 103 for calculating the image ratio on the basis of the thus measured amount of image information. When the calculated image ratio of the CPU 103 exceeds a set value, the set rotation driving period of the developing sleeve 4a is increased.

[Claims]

[Claim 1] A developing apparatus having a developing agent carrier which is arranged oppositely to a latent image carrier carrying a latent image corresponding to image information, carries a developing agent on the surface thereof, and is rotatable around the axis thereof; said developing apparatus developing said latent image through visualization thereof as a developing agent image by the developing agent imparted to said latent image carrier by said developing agent carrier; said developing apparatus having a configuration in which the developing agent on the developing agent carrier is frictionally charged by the rotation of the developing agent carrier, and the developing agent carrier is subjected to a developing processing after rotational driving for a predetermined rotational driving period; wherein said developing apparatus comprises measuring means for measuring the amount of image information, and calculating means for calculating the image ratio on the basis of the amount of image information measured by the measuring means; and when the image ratio calculated by the calculating means exceeds a set value, the set rotational driving period of the developing agent carrier is increased.

[Claim 2] A developing apparatus having a developing agent carrier which is arranged oppositely to a latent image carrier carrying a latent image corresponding to

image information, carries a developing agent on the surface thereof, and is rotatable around the axis thereof; said developing apparatus developing said latent image through visualization thereof as a developing agent image by the developing agent imparted to said latent image carrier by said developing agent carrier; said developing apparatus having a configuration in which the developing agent on the developing agent carrier is frictionally charged by the rotation of the developing agent carrier, and the developing agent carrier is subjected to developing processing after rotational driving for a predetermined rotational driving period; wherein said developing apparatus comprises measuring means for measuring the amount of image information, calculating means for calculating the image ratio on the basis of the amount of image information measured by the measuring means, and memory means for storing the calculated image ratio of the calculating means; and when the calculated image ratio of the calculating means stored in the memory means exceeds a certain set value continuously for a predetermined number of runs, the set rotational driving period of the developing agent carrier is increased.

[Claim 3] A developing apparatus having a developing agent carrier which is arranged oppositely to a latent image carrier carrying a latent image corresponding to

image information, carries a developing agent on the surface thereof, and is rotatable around the axis thereof; said developing apparatus developing said latent image through visualization thereof as a developing agent image by the developing agent imparted to said latent image carrier by said developing agent carrier; said developing apparatus having a configuration in which the developing agent on the developing agent carrier is frictionally charged by the rotation of the developing agent carrier, and the developing agent carrier is subjected to developing processing after rotational driving for a predetermined rotational driving period; wherein said developing apparatus comprises measuring means for measuring the amount of image information, calculating means for calculating the image ratio on the basis of the amount of image information measured by the measuring means, and memory means for storing calculated image ratio of the calculating means; and when the average value of calculated image ratios of the calculating means stored in the memory means exceeds a set value, the set rotational driving period of the developing agent carrier is increased.

[Claim 4] An image forming apparatus for recording an image formed by a series of image forming processes in a recording medium, comprising the developing apparatus according to any one of the first to third inventions.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The present invention relates to an image forming apparatus adopting the electrophotographic process.

[0002]

[Description of the Related Art] Fig. 7 is a schematic sectional view illustrating a color laser beam printer as an example of the conventional image forming apparatus.

[0003] Such a color laser beam printer has process cartridges 240, 241, 242, 243 and 244 detachable from the main body. The process cartridge 240 has a photosensitive drum 1 serving as a latent image carrier. The process cartridges 241, 242, 243 and 244 are developing units serving as developing apparatuses for individual colors (yellow, magenta, cyan and black).

[0004] The photosensitive drum 201 is rotationally driven at a prescribed circumferential speed (process speed) in the arrow direction. In the course of rotation thereof, the photosensitive drum 201 is uniformly charge-processed to prescribed polarity and potential by a primary charging roller 202. Then, an electrostatic latent image corresponding to a first color component image (for example, yellow component image) of an object image is formed by being subjected to image exposure 203 by image exposing means (not

shown) such as a color original image color separation and image forming/exposure optical system and a scanning exposure system based on a laser scanner which inputs a laser beam modulated in response to a time-serial electric digital image signal of the image information.

[0005] Then, the electrostatic latent image is developed by yellow toner Y, a first color developing agent, in a first developing unit 241 (yellow developing unit). The developing units 241, 242, 243 and 244 for the respective colors (yellow, magenta, cyan and black) are rotated in the arrow direction in the drawing by a rotational driver (not shown) so that each developing unit selectively faces the photosensitive drum 201 during the developing process.

[0006] The developing units 241, 242, 243 and 244 have each a developing sleeve 204a, a developing agent carrier. When facing the photosensitive drum 201, the developing sleeve 204a rotates in the positive direction to that of the photosensitive drum 201. The surface thereof has appropriate irregularities to increase the sliding friction probability with the toner and to ensure satisfactory conveyance of the toner.

[0007] A developing blade 204b is provided thereabove so as to come into surface contact with the outer peripheral surface of the developing sleeve 204a. An

elastic roller 204c is in contact and rotatably supported in further upstream in the rotating direction of the developing sleeve 204a.

[0008] The toner in the developing unit is fed to the elastic roller 204a along with the rotation of a stirring member 204d during the developing operation. The toner is conveyed to a proximity of the developing sleeve 204a under the effect of rotation of the elastic roller 204c. The toner carried on the elastic roller 204c at the contact portion of the developing sleeve 204a and the elastic roller 204c is deposited onto the developing sleeve 204a by triboelectric charge caused by friction with the developing sleeve 204a. Thereafter, the toner is sent to the pressure-contact portion of the developing blade 204b along with the rotation of the developing sleeve 204a, where the toner is subjected to an appropriate tribo (triboelectric amount). After formation of a thin layer on the developing sleeve 204a, the toner is conveyed to the developing section facing the photosensitive drum 1 and subjected to development.

[0009] The intermediate transfer member 205 is rotationally driven anticlockwise in the arrow direction at the same circumferential speed as that of the photosensitive drum 201. A yellow toner image of the above-mentioned first color formed and carried on the photosensitive drum 1 is intermediately transferred

onto the outer peripheral surface of an intermediate transfer member 205, under the effect of an electric field formed by a primary transfer bias applied to the intermediate transfer member 205 and a pressure exerted by a nip portion, during passage through a nip portion between the photosensitive drum 201 and the intermediate transfer member 205. This process will hereinafter be referred to as the "primary transfer".

[0010] Thereafter, a magenta toner image of the second color, a cyan toner image of the third color, and a black toner image of the fourth color are similarly transferred in superposition on the intermediate transfer member 205, and a synthetic color toner image corresponding to the object color image is thus formed.

[0011] The transfer of the synthetic color toner image transferred in superposition on the intermediate transfer member 205 onto the transfer material P which is a recording medium is accomplished through contact of a transfer roller 206 with the intermediate transfer member 205, through feeding of the transfer material P at a prescribed timing from a paper feed cassette (not shown) to the contact nip between the intermediate transfer member 205 and the transfer roller 206, and through application of a secondary transfer bias to the transfer roller 206. This secondary transfer bias transfers the synthetic color toner image from the intermediate transfer member 205 to the transfer

material P. This process is referred to as the "secondary transfer".

[0012] The transfer material P to which the toner image has been transferred and which has been separated from the intermediate transfer member 205 is introduced into a fixing unit 15 to heat and fix.

[0013]

[Problems to be Solved by the Invention] However, the conventional image forming apparatus described above has the following problems.

[0014] With the recent development of computer networks, printers and copy machines are experiencing severe circumstances which they have to cope with diverse and various needs demanded by many users. The various needs include, for example, images having a large amount of print such as solid images and photographic images, and originals of a small amount of print such as text manuscripts mainly comprising black toner. In a multiple-transfer type full-color printer or copying machine, tribo conditions of the toner in the developing unit or on the developing sleeve are not always the same for the individual colors, when comparing an image of a large amount of print such as a solid image of a photographic image and an image of a small amount of print such as a text manuscript, or as a result of a difference in the frequency of use between colors. A low print ratio corresponds to a

smaller toner consumption on the developing sleeve. In the case of a developing apparatus having the above-mentioned configuration, tribo is imparted to the toner on the developing sleeve upon every passage of the elastic blade, leading to a uniform and stable tribo state of the toner. In the case of a high print ratio, in contrast, a rapid consumption of the toner corresponds to a smaller number of chances in which tribo is imparted to the toner on the developing sleeve or in the developing apparatus. This leads to a lower tribo of the toner, bringing about an instable state in which a uniform, stable and satisfactory image may be unavailable.

[0015] Therefore, it is an object of the present invention to provide a developing apparatus which makes it possible to carry out a stable developing processing by supplying sufficient tribo to a developing agent on a developing agent carrier even when the developing agent in the developing apparatus is rapidly consumed, and an image forming apparatus having such a developing apparatus.

[0016]

[Means for Solving the Problems] According to the present application, the above-mentioned object is achieved by a first invention which provides a developing apparatus having a developing agent carrier which is arranged oppositely to a latent image carrier

carrying a latent image corresponding to image information, carries a developing agent on the surface thereof, and is rotatable around the axis thereof; said developing apparatus developing said latent image through visualization thereof as a developing agent image by the developing agent imparted to said latent image carrier by said developing agent carrier; said developing apparatus having a configuration in which the developing agent on the developing agent carrier is frictionally charged by the rotation of the developing agent carrier, and the developing agent carrier is subjected to a developing processing after rotational driving for a predetermined rotational driving period; wherein said developing apparatus comprises measuring means for measuring the amount of image information, and calculating means for calculating the image ratio on the basis of the amount of image information measured by the measuring means; and when the image ratio calculated by the calculating means exceeds a set value, the set rotational driving period of the developing agent carrier is increased.

[0017] According to the present application, the above-mentioned object is achievable also by a second invention which provides a developing apparatus having a developing agent carrier which is arranged oppositely to a latent image carrier carrying a latent image corresponding to image information, carries a

developing agent on the surface thereof, and is rotatable around the axis thereof; said developing apparatus developing said latent image through visualization thereof as a developing agent image by the developing agent imparted to said latent image carrier by said developing agent carrier; said developing apparatus having a configuration in which the developing agent on the developing agent carrier is frictionally charged by the rotation of the developing agent carrier, and the developing agent carrier is subjected to developing processing after rotational driving for a predetermined rotational driving period; wherein said developing apparatus comprises measuring means for measuring the amount of image information, calculating means for calculating the image ratio on the basis of the amount of image information measured by the measuring means, and memory means for storing the calculated image ratio of the calculating means; and when the calculated image ratio of the calculating means stored in the memory means exceeds a certain set value continuously for a predetermined number of runs, the set rotational driving period of the developing agent carrier is increased.

[0018] According to the present application, the above-mentioned object is achievable also by a third invention which provides a developing apparatus having a developing agent carrier which is arranged oppositely

to a latent image carrier carrying a latent image corresponding to image information, carries a developing agent on the surface thereof, and is rotatable around the axis thereof; said developing apparatus developing said latent image through visualization thereof as a developing agent image by the developing agent imparted to said latent image carrier by said developing agent carrier; said developing apparatus having a configuration in which the developing agent on the developing agent carrier is frictionally charged by the rotation of the developing agent carrier, and the developing agent carrier is subjected to developing processing after rotational driving for a predetermined rotational driving period; wherein said developing apparatus comprises measuring means for measuring the amount of image information, calculating means for calculating the image ratio on the basis of the amount of image information measured by the measuring means, and memory means for storing calculated image ratio of the calculating means; and when the average value of calculated image ratios of the calculating means stored in the memory means exceeds a set value, the set rotational driving period of the developing agent carrier is increased.

[0019] According to the present application, the above-mentioned object is achievable also by a fourth invention which provides an image forming apparatus for

recording an image formed by a series of image forming processes in a recording medium, comprising the developing apparatus according to any one of the first to third inventions.

[0020] In other words, in the first invention of the present application, the set rotational driving period of the developing agent carrier is increased when the image ratio exceeds a certain set value, and the developing agent carrier is used for developing processing after rotational driving for the set rotational driving period.

[0021] In the second invention of the present application, the set rotational driving period of the developing agent carrier is increased when the calculated image ratio of the calculating means stored in the memory means exceeds a set value continuously for a predetermined number of runs, and the developing agent carrier is used for developing processing after rotational driving for the set rotational driving period.

[0022] In the third invention of the present application, the set rotational driving period of the developing agent carrier is increased when the average value of the calculated image ratios of the calculating means stored in the memory means exceeds a set value at a predetermined number of runs, and after rotational driving for the set rotational driving period, the

developing agent carrier is used for developing processing.

[0023] In the fourth invention of the present application, the set rotational driving period of the developing agent carrier is increased when the image ratio, or the calculated image ratio of the calculating means stored in the memory means, or the average value of the calculated image ratios of the calculating means stored in the memory means exceeds a set value continuously for a predetermined number of runs.

[0024]

[Embodiments] Embodiments of the present invention will now be described with reference to the attached drawings.

[0025] (First Embodiment) The first embodiment of the present invention will be described.

[0026] Fig. 1 is a schematic configurational view of the main portions of a laser beam printer (hereinafter referred to as a "printer") which is an example of the image forming apparatus of the first embodiment.

[0027] The printer of this embodiment has a detachable process cartridge 4.

[0028] A photosensitive drum 1 which is a latent image carrier is rotationally driven at a prescribed speed (process speed) in the arrow direction, and charging-processed to prescribed polarity and potential by a primary charging roller 2 in the course of rotation

thereof. Then, an electrostatic latent image corresponding to the object image is formed by image exposure applied by image exposing means (not shown).

[0029] Then, tone, a developing agent, is imparted by a developing unit 45 serving as a developing apparatus to the photosensitive drum 1 carrying this latent image, whereby the latent image is visualized as a toner image and developed.

[0030] The toner image is formed on the photosensitive drum 1. A transfer material P serving as a recording medium is fed at a prescribed timing from a paper feed cassette (not shown) to a contact nip between the photosensitive drum 1 and the transfer roller 6, and at the same time, a transfer bias is applied to the transfer roller 6. The transfer bias causes transfer of the toner image from the photosensitive drum 1 onto the transfer material P.

[0031] After the transfer of the toner image, the transfer material P separated from the photosensitive drum 1 is introduced into a fixing unit 15, heated and fixed.

[0032] The developing unit 45 will now be described in detail.

[0033] The developing unit 45 has a developing sleeve 4a serving as a developing agent carrier. The developing sleeve 4a rotates in a positive direction along that of the photosensitive drum 1, and the

surface thereof has appropriate irregularities to ensure a high probability of friction with the toner and satisfactory conveyance of the toner.

[0034] A developing blade 4b is provided thereabove so as to come into surface contact with the outer peripheral surface of the developing sleeve 4a. In the further upstream of the developing sleeve in the rotating direction, an elastic roller 4c is in contact therewith, and rotatably supported.

[0035] The toner in the developing unit 45 is fed to the elastic roller 4c along with the rotation of a stirring member 4d during the developing operation. Furthermore, under the effect of the rotation of the elastic roller 4c, the toner is conveyed to a proximity of the developing sleeve 4a. At the contact portion of the developing sleeve 4a and the elastic roller 4c, the toner carried on the elastic roller 4c is subjected to triboelectric charge through friction with the developing sleeve 4a, and deposited onto the developing sleeve 4a. Thereafter, the toner is sent to the pressure contact portion of the developing blade 4b along with the rotation of the developing sleeve 4a, where the toner is subjected to an appropriate tribo (triboelectricity). After formation of a thin layer on the developing sleeve 4a, the toner is conveyed to a developing section facing the photosensitive drum 1, the toner is used for development.

[0036] In Fig. 2, a dot counter 101 which is measuring means provided in a controller 110 measures the number of dots (amount of image information) of image signals outputted from an image output section 102. The number of printed dots measured here is converted into a print ratio (image ratio) X relative to the media to be printed.

[0037] The means for measuring the print amount information used in the present invention, for example, converts the emitting period of the laser, or counts the individual image signals forming dots of the individual images and converts the result. No limitation is however imposed on the means for measuring the print amount information so far as it permits measurement of the print amount information (print ratio) of the images.

[0038] In a developing apparatus having the configuration as described above, tribo conditions of the toner in the developing unit or on the developing sleeve are not always the same for the individual colors, when comparing an image of a large amount of print such as a solid image or a photographic image and an image of a small amount of print such as a text manuscript. A low print ratio corresponds to a smaller toner consumption on the developing sleeve. Tribo imparted to the toner on the developing sleeve upon every passage of the elastic blade leads to a uniform

and stable tribo state of the toner. In the case of a high print ratio, in contrast, a rapid consumption of the toner corresponds to a smaller number of chances in which tribo is imparted on the developing sleeve or in the developing apparatus. This leads to a lower tribo of the toner, bringing about an instable state in which a uniform, stable and satisfactory image may be unavailable.

[0039] Therefore, when two predetermined stages including print ratios Y1 and Y2 are provided, the print ratio X converted by the above-mentioned method is determined by comparing the two print ratios within the CPU 103. For example, on the assumption of $Y1 < Y2$, three cases of comparison including (1) $X < Y1$, (2) $Y1 \leq X \leq Y2$, and (3) $Y1 < X$ are performed.

[0040] According to the result of this comparison, the pre-printing preparing operation period (rotation period after printing, or rotation period in the next run of printing) is varied.

[0041] The pre-printing preparing operation period mainly depends upon the rising period of the fixing unit or the laser scanner and the conveying period of the transfer material. A shorter period is preferable. In the case of an image forming apparatus used in this embodiment, it is assumed that rotation is conducted for ten seconds in total, including post-rotation after the completion of development of the developing

apparatus for five seconds and pre-rotation before developing for another five seconds. Under some conditions in this case, the result of assessment of the image immediately after attainment of high print ratios, and the result with a longer pre-printing preparing operation period are shown in Table 1. Table 1 suggests that defective image can be eliminated according as the pre-printing preparing operation period is extended by five, and then seven seconds:

[0042]

[Table 1]

PRE-PRINTING PREPARING OPERATION PERIOD \ PRINT RATIO	50%	70%	90%
10 sec	○	Δ	×
15 sec	○	○	Δ
17 sec	○	○	○

[0043] Therefore, the toner tribo in the developing unit 45 is stabilized, on the assumption of predetermined print ratios Y1 of 70% and Y2 of 90%, and comparing the converted print ratio X with the above-mentioned condition formula.

[0044] As described above, a satisfactory image can be obtained by supplying sufficient tribo to the toner by

extending the pre-printing preparing operation period in response to the print ratio.

[0045] (Second Embodiment) A second embodiment of the present invention will now be described.

[0046] Fig. 3 is a schematic configurational view of main portions of a color laser beam printer, an example of the image forming apparatus of the second embodiment.

[0047] The printer of this embodiment has process cartridges 40, 41, 42, 43 and 44 detachable from the apparatus main body. The process cartridge 40 has a photosensitive drum 1 (image carrier); and process cartridges 41, 42, 43 and 44 are developing units serving as developing apparatuses for the individual colors (yellow, magenta, cyan and black).

[0048] The photosensitive drum 1 is rotationally driven at a prescribed circumferential speed (process speed) in the arrow direction, and uniformly charging-processed to prescribed polarity and potential by a primary charging roller 2 during rotation. Then, through image exposure 3 by image exposing means (not shown) such as a color separation/image forming-exposure optical system of a color original image or a scanning exposure system based on a laser scanner outputting a laser beam modulated for time-serial electric digital image signals of the image information, an electrostatic latent image corresponding to a first color component image (for example, a yellow component

image) of the object color image is formed.

[0049] Then, the electrostatic latent image is developed by the yellow toner Y, a developing agent for a first color, by use of the first developing unit 41 (yellow developing unit). The developing units 41, 42, 43 and 44 (yellow, magenta, cyan and black) are rotated by a rotational driver (not shown) in the arrow direction in the drawing, and are arranged so that the individual developing units selectively face the photosensitive drum 1.

[0050] The intermediate transfer member 5 is rotationally driven anticlockwise in the arrow direction at the same circumferential speed as that of the photosensitive drum 1. A yellow toner image of the above-mentioned first color formed and carried on the photosensitive drum 1 is intermediately transferred onto the outer peripheral surface of an intermediate transfer member 5, under the effect of an electric field formed by a primary transfer bias applied to the intermediate transfer member 5 and a pressure exerted by a nip portion, during passage through a nip portion between the photosensitive drum 1 and the intermediate transfer member 5. This process will hereinafter referred to as the "primary transfer".

[0051] Thereafter, a magenta toner image of the second color, a cyan toner image of the third color, and a black toner image of the fourth color are similarly

transferred in superposition on the intermediate transfer member 5, and a synthetic color toner image corresponding to the object color image is thus formed.

[0052] The transfer of the synthetic color toner image transferred in superposition on the intermediate transfer member 5 onto the transfer material P is accomplished through contact of a transfer roller 6 with the intermediate transfer member 5, through feeding of the transfer material P at a prescribed timing from a paper feed cassette (not shown) to the contact nip between the intermediate transfer member 5 and the transfer roller 6, and through application of a secondary transfer bias to the transfer roller 6. This secondary transfer bias transfers the synthetic color toner image from the intermediate transfer member 5 to the transfer material P. This process is referred to as the "secondary transfer".

[0053] The transfer material P to which the toner image has been transferred and which has been separated from the intermediate transfer member 5 is introduced into a fixing unit 15 to heat and fix.

[0054] The developing units 41, 42, 43 and 44 will now be described in detail.

[0055] The developing units 41, 42, 43 and 44 have each a developing sleeve 4a, a developing agent carrier. When facing the photosensitive drum 1, the developing sleeve 4a rotates in the positive direction to that of

the photosensitive drum 1. The surface thereof has appropriate irregularities to increase the sliding friction probability with the toner and to ensure satisfactory conveyance of the toner.

[0056] A developing blade 4b is provided thereabove so as to come into surface contact with the outer peripheral surface of the developing sleeve 4a. An elastic roller 4c is in contact and rotatably supported in further upstream in the rotating direction of the developing sleeve 4a.

[0057] The toner in the developing unit is fed to the elastic roller 4a along with the rotation of a stirring member 4d during the developing operation. The toner is conveyed to a proximity of the developing sleeve 4a under the effect of rotation of the elastic roller 4c. The toner carried on the elastic roller 4c at the contact portion of the developing sleeve 4a and the elastic roller 4c is deposited onto the developing sleeve 4a by triboelectric charge caused by friction with the developing sleeve 4a. Thereafter, the toner is sent to the pressure-contact portion of the developing blade 4b along with the rotation of the developing sleeve 4a, where the toner is subjected to an appropriate tribo (triboelectric amount). After formation of a thin layer on the developing sleeve 4a, the toner is conveyed to the developing section facing the photosensitive drum 1 and subjected to development.

[0058] In Fig. 4, a dot counter 101, measuring means provided in a controller 110, measures the number of dots of image signals outputted from an image output section 102. The number of dots measured here is converted into a print ratio X relative to the media printed by the CPU 103, calculating means. The print ratio measured here are written for each color in the memory means 100.

[0059] No particular limitation is imposed on the memory means 100 used in this embodiment so far as it is capable of rewritably storing and retaining signal information. Applicable memory means include, for example, electric memory means such as a RAM and a rewritable ROM, and magnetic recording means such as a magnetic recording medium, a magnetic bubble memory and a magneto-optical memory. Means for measuring print amount information used in the present invention include means converting a laser emitting period, and means converting individual counted image signals constituting dots of each image. No limitation is imposed so far as the print amount information of each image (print ratio) is measurable.

[0060] In an image forming apparatus or a developing apparatus having the configuration as described above, tribo conditions of the toner in the developing unit or on the developing sleeve are not always the same for the individual colors, when comparing an image of a

large amount of print such as a solid image or a photographic image and an image of a small amount of print such as a text manuscript. A low print ratio corresponds to a smaller toner consumption on the developing sleeve. Tribo imparted to the toner on the developing sleeve upon every passage of the elastic blade leads to a uniform and stable tribo state of the toner. In the case of a high print ratio, in contrast, a rapid consumption of the toner corresponds to a smaller number of chances in which tribo is imparted on the developing sleeve or in the developing apparatus. This leads to a lower tribo of the toner, bringing about an instable state in which a uniform, stable and satisfactory image may be unavailable.

[0061] Therefore, from among the print ratio information written in the memory means 100, the print ratios and the history of the print ratios are compared by the CPU 103 with a predetermined print ratio X' and a number of successive sheets Y'. For example, the predetermined print ratio X' and the number of successive sheets Y' are assumed to be X' = 50% and Y' = 5 sheets. In the developing units showing five or more sheets of an image having a print ratio of over 50%, the pre-printing preparing operation period (post-rotation period after printing, or the pre-printing period prior to the next printing) is extended.

[0062] The pre-printing preparing operation period

mainly depends upon the rising period of the fixing unit or the laser scanner and the conveying period of the transfer material. A shorter period is preferable.

In the case of an image forming apparatus used in this embodiment, it is assumed that rotation is conducted for ten seconds in total, including post-rotation after the completion of development of the developing apparatus for five seconds and the pre-rotation before developing for another five seconds. Under some conditions in this case, the result of image assessment immediately after printing successively five sheets of an image with a print ratio of 50%, and the result of extension of the pre-printing preparing operation period are shown in Table 2. This suggests the possibility to eliminate a defective image by increasing the pre-printing preparing operation period.

[0063]

[Table 2]

PRE-PRINTING PREPARING OPERATION PERIOD	IMAGE AFTER FIVE IMAGES OF 50%
10 sec	×
15 sec	Δ
20 sec	○

[0064] When images of a high print ratio are printed in succession as described above, it is possible to

obtain a satisfactory image by supplying sufficient tribo to the toner by extending the pre-printing preparing operation period.

[0065] (Third Embodiment) A third embodiment of the present invention will now be described.

[0066] Fig. 5 is a schematic configurational view of main portions of a color laser beam printer, an example of the image forming apparatus of the third embodiment.

[0067] The printer of this embodiment has process cartridges 40, 41, 42, 43 and 44 detachable from the apparatus main body. The process cartridge 40 has a photosensitive drum 1 (image carrier); and process cartridges 41, 42, 43 and 44 are developing units serving as developing apparatuses for the individual colors (yellow, magenta, cyan and black).

[0068] The photosensitive drum 1 is rotationally driven at a prescribed circumferential speed (process speed) in the arrow direction, and uniformly charging-processed to prescribed polarity and potential by a primary charging roller 2 during rotation. Then, through image exposure 3 by image exposing means (not shown) such as a color separation/image forming-exposure optical system of a color original image or a scanning exposure system based on a laser scanner outputting a laser beam modulated for time-serial electric digital image signals of the image information, an electrostatic latent image corresponding to a first

color component image (for example, a yellow component image) of the object color image is formed.

[0069] Then, the electrostatic latent image is developed by the yellow toner Y, a developing agent for a first color, by use of the first developing unit 41 (yellow developing unit). The developing units 41, 42, 43 and 44 (yellow, magenta, cyan and black) are rotated by a rotational driver (not shown) in the arrow direction in the drawing, and are arranged so that the individual developing units selectively face the photosensitive drum 1.

[0070] The intermediate transfer member 5 is rotationally driven anticlockwise in the arrow direction at the same circumferential speed as that of the photosensitive drum 1. A yellow toner image of the above-mentioned first color formed and carried on the photosensitive drum 1 is intermediately transferred onto the outer peripheral surface of an intermediate transfer member 5, under the effect of an electric field formed by a primary transfer bias applied to the intermediate transfer member 5 and a pressure exerted by a nip portion, during passage through a nip portion between the photosensitive drum 1 and the intermediate transfer member 5. This process will hereinafter be referred to as the "primary transfer".

[0071] Thereafter, a magenta toner image of the second color, a cyan toner image of the third color, and a

black toner image of the fourth color are similarly transferred in superposition on the intermediate transfer member 5, and a synthetic color toner image corresponding to the object color image is thus formed.

[0072] The transfer of the synthetic color toner image transferred in superposition on the intermediate transfer member 5 onto the transfer material P is accomplished through contact of a transfer roller 6 with the intermediate transfer member 5, through feeding of the transfer material P at a prescribed timing from a paper feed cassette (not shown) to the contact nip between the intermediate transfer member 5 and the transfer roller 6, and through application of a secondary transfer bias to the transfer roller 6. This secondary transfer bias transfers the synthetic color toner image from the intermediate transfer member 5 to the transfer material P. This process is referred to as the "secondary transfer".

[0073] The transfer material P to which the toner image has been transferred and which has been separated from the intermediate transfer member 5 is introduced into a fixing unit 15 to heat and fix.

[0074] The developing units 41, 42, 43 and 44 will now be described in detail.

[0075] The developing units 41, 42, 43 and 44 have each a developing sleeve 4a, a developing agent carrier. When facing the photosensitive drum 1, the developing

sleeve 4a rotates in the positive direction to that of the photosensitive drum 1. The surface thereof has appropriate irregularities to increase the sliding friction probability with the toner and to ensure satisfactory conveyance of the toner.

[0076] A developing blade 4b is provided thereabove so as to come into surface contact with the outer peripheral surface of the developing sleeve 4a. An elastic roller 4c is in contact and rotatably supported in further upstream in the rotating direction of the developing sleeve 4a.

[0077] The toner in the developing unit is fed to the elastic roller 4a along with the rotation of a stirring member 4d during the developing operation. The toner is conveyed to a proximity of the developing sleeve 4a under the effect of rotation of the elastic roller 4c. The toner carried on the elastic roller 4c at the contact portion of the developing sleeve 4a and the elastic roller 4c is deposited onto the developing sleeve 4a by triboelectric charge caused by friction with the developing sleeve 4a. Thereafter, the toner is sent to the pressure-contact portion of the developing blade 4b along with the rotation of the developing sleeve 4a, where the toner is subjected to an appropriate tribo (triboelectric amount). After formation of a thin layer on the developing sleeve 4a, the toner is conveyed to the developing section facing

the photosensitive drum 1 and subjected to development.

[0078] In Fig. 6, a dot counter 101, measuring means provided in a controller 110, measures the number of dots of image signals outputted from an image output section 102. The number of dots measured here is converted into a print ratio X relative to the media printed by the CPU 103, calculating means. The print ratio measured here are written for each color in the memory means 100.

[0079] No particular limitation is imposed on the memory means 100 used in this embodiment so far as it is capable of rewritably storing and retaining signal information. Applicable memory means include, for example, electric memory means such as a RAM and a rewritable ROM, and magnetic recording means such as a magnetic recording medium, a magnetic bubble memory and a magneto-optical memory. Means for measuring print amount information used in the present invention include means converting a laser emitting period, and means converting individual counted image signals constituting dots of each image. No limitation is imposed so far as the print amount information of each image (print ratio) is measurable.

[0080] In an image forming apparatus or a developing apparatus having the configuration as described above, tribo conditions of the toner in the developing unit or on the developing sleeve are not always the same for

the individual colors, when comparing an image of a large amount of print such as a solid image or a photographic image and an image of a small amount of print such as a text manuscript. A low print ratio corresponds to a smaller toner consumption on the developing sleeve. Tribo imparted to the toner on the developing sleeve upon every passage of the elastic blade leads to a uniform and stable tribo state of the toner. In the case of a high print ratio, in contrast, a rapid consumption of the toner corresponds to a smaller number of chances in which tribo is imparted on the developing sleeve or in the developing apparatus. This leads to a lower tribo of the toner, bringing about an instable state in which a uniform, stable and satisfactory image may be unavailable.

[0081] From among the pieces of print ratio information written in the memory means 100, an average print ratio A calculated by the CPU 103 from the print ratios and the print ratio history is compared with a predetermined average print ratio A'. For example, the predetermined average print ratio A' is assumed to be A' = 50%. For a developing unit showing an average print ratio of over 50% for the past ten sheets, the pre-print preparing operation period (post-rotation period after printing, or pre-rotation period during the next printing) is extended.

[0082] The pre-printing preparing operation period

mainly depends upon the rising period of the fixing unit or the laser scanner and the conveying period of the transfer material. A shorter period is preferable.

In the case of an image forming apparatus used in this embodiment, it is assumed that rotation is conducted for ten seconds in total, including post-rotation after the completion of development of the developing apparatus for five seconds and pre-rotation before developing for another five seconds. Under some conditions in this case, the result of image assessment immediately after printing when the past ten sheets show an average print ratio of 50%, and the result of extension of the pre-printing preparing operation period are shown in Table 3. This suggests the possibility to eliminate a defective image by increasing the pre-printing preparing operation period.

[0083]

[Table 3]

PRE-PRINTING PREPARING OPERATION PERIOD	IMAGE IMMEDIATELY AFTER AN AVERAGE PRINT RATIO OF 50% IS REACHED
10 sec	×
15 sec	Δ
20 sec	○

[0084] When the average print ratio become higher as

described above, it is possible to obtain a satisfactory image by supplying sufficient tribo to the toner by extending the pre-printing preparing operation period.

[0085]

[Advantages] According to the first invention of the present application, as described above, the set rotational driving period of the developing agent carrier is increased when the image ratio exceeds a certain set value, and the developing agent carrier is used for developing processing after rotational driving for the set rotational driving period. Even when the developing agent in the developing apparatus is consumed rapidly, therefore, it is possible to apply a stable developing processing by supplying sufficient tribo to the developing agent on the developing agent carrier.

[0086] According to the second invention of the present application, the set rotational driving period of the developing agent carrier is increased when the calculated image ratio of the calculating means stored in the memory means exceeds a set value continuously for a predetermined number of runs, and the developing agent carrier is used for developing processing after rotational driving for the next rotational driving period. Even when the developing agent in the developing apparatus is consumed rapidly, therefore, it

is possible to apply a stable developing processing by supplying sufficient tribo to the developing agent on the developing agent carrier.

[0087] According to the third invention of the present application, the set rotational driving period of the developing agent carrier is increased when the average value of the calculated image ratios of the calculating means stored in the memory means exceeds a set value at a predetermined number of runs, and after rotational driving for the set rotational driving period, the developing agent carrier is used for developing processing. Even when the developing agent in the developing apparatus is consumed rapidly, therefore, it is possible to apply a stable developing processing by supplying sufficient tribo to the developing agent on the developing agent carrier.

[0088] According to the fourth invention of the present application, the set rotational driving period of the developing agent carrier is increased when the image ratio, or the calculated image ratio of the calculating means stored in the memory means or the average value of the calculated image ratios of the calculating means stored in the memory means exceeds a set value continuously for a predetermined number of runs. Even when the developing agent in the developing apparatus is consumed rapidly, therefore, it is possible to apply a stable developing processing by

supplying sufficient tribo to the developing agent on the developing agent carrier.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 is a sectional view illustrating a schematic configuration of the image forming apparatus of a first embodiment.

[Fig. 2] Fig. 2 illustrates the operation of the image forming apparatus of the first embodiment.

[Fig. 3] Fig. 3 is a sectional view illustrating a schematic configuration of the image forming apparatus of a second embodiment.

[Fig. 4] Fig. 4 illustrates the operation of the image forming apparatus of the second embodiment.

[Fig. 5] Fig. 5 is a sectional view illustrating a schematic configuration of the image forming apparatus of a third embodiment.

[Fig. 6] Fig. 6 illustrates the operation of the image forming apparatus of the third embodiment.

[Fig. 7] Fig. 7 is a sectional view illustrating a schematic configuration of the conventional image forming apparatus.

[Reference Numerals]

1: Photosensitive drum (latent image carrier)

2: Primary charging roller

3: Image exposure

4: Process cartridge

4a: Developing sleeve (developing agent carrier)

4b: Developing blade

4c: Elastic roller

4d: Stirring member

5: Intermediate transfer member

6: Transfer roller

15: Fixing unit

40, 41, 42, 43, 44: Process cartridge

41, 42, 43, 44: Developing unit (developing apparatus)

100: Memory means

101: Dot counter (measuring means)

102: Image output section

103: CPU (calculating means)

110: Controller

P: Transfer material (recording medium)

Y: Yellow toner (developing agent)

FIG. 2

101: COUNTER

102: IMAGE OUTPUT SECTION

(1) PRINTING INSTRUCTION

FIG. 4

100: MEMORY MEANS

101: COUNTER

102: IMAGE OUTPUT SECTION

(1) PRINTING INSTRUCTION

FIG. 6

100: MEMORY MEANS

101: COUNTER

102: IMAGE OUTPUT SECTION

(1) PRINTING INSTRUCTION

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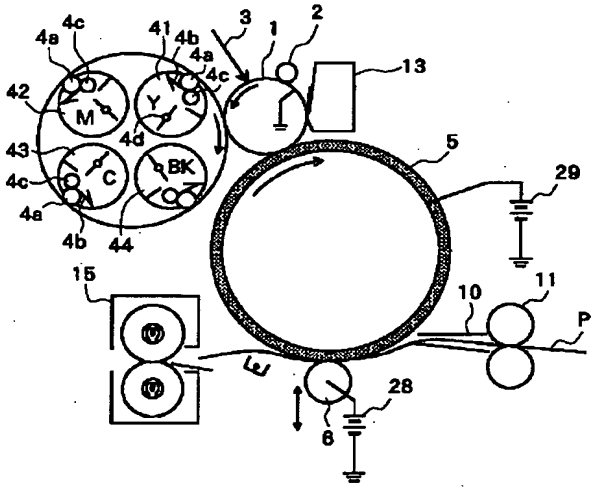
最終頁に続く

(54)【発明の名称】　画像形成装置

(57)【要約】
【課題】　トナーの消費が少ない場合でも不良画像の発生を防止することのできる画像形成装置を提供する。
【解決手段】　露光手段により像担持体１を露光して像担持体上に形成された静電潜像を、複数の色のトナーＹ，Ｍ，Ｃ，ＢＫをそれぞれ収納した複数の現像手段４１，４２，４３，４４により現像する。また、カウンタによりトナー画像が転写されたシートＰの枚数をカウントすると共に、現像率計測手段により各現像手段４１，４２，４３，４４の静電潜像に対する現像の割合をそれぞれ計測する。そして、カウンタのカウント値及び現像率計測手段の計測値に基づき、現像の割合が所定の割合よりも低い現像手段が発生し、かつこの現像割合の低い現像手段により現像されたトナー画像が転写されたシートＰが所定枚数連続した場合、露光手段を制御し、この現像割合の低い現像手段による静電潜像に対する現像の割合が高い静電潜像を形成する。



【特許請求の範囲】

【請求項１】　像担持体を露光して像担持体上に静電潜像を形成した後、前記静電潜像を複数の色のトナーにより現像してトナー画像を形成し、この後、前記トナー画像をシートに転写するようにした画像形成装置において、

前記複数の色のトナーをそれぞれ収納すると共に収納した前記トナーにより前記静電潜像を順次現像する複数の現像手段を備え、

前記複数の現像手段の前記静電潜像に対するそれぞれの現像の割合を計測すると共に、前記現像の割合が所定の割合よりも低い現像手段が発生し、かつ該現像割合の低い現像手段により現像されたトナー画像が転写されたシートが所定枚数連続した場合、前記現像割合の低い現像手段による現像の割合の高い静電画像を形成するようにしたことを特徴とする画像形成装置。

【請求項２】　前記像担持体を露光する露光手段と、

前記トナー画像が転写されたシートの枚数をカウントするカウンタと、

前記複数の各現像手段の静電潜像に対する現像の割合をそれぞれ計測する現像率計測手段と、

前記カウンタのカウント値及び現像率計測手段の計測値に基づき、前記現像割合の低い現像手段が発生し、かつ前記現像割合が低い現像手段により現像されたトナー画像が転写されたシートが所定枚数連続したと判断した場合、前記現像割合の低い現像手段による現像の割合が高い静電潜像を形成するよう前記露光手段を制御する制御手段と、

を備えたことを特徴とする請求項１記載の画像形成装置。

【請求項３】　像担持体を露光して像担持体上に静電潜像を形成した後、前記静電潜像を複数の色のトナーにより現像してトナー画像を形成し、この後、前記トナー画像をシートに転写するようにした画像形成装置において、

前記複数の色のトナーをそれぞれ収納すると共に収納した前記トナーにより前記静電潜像を順次現像する複数の現像手段を備え、

前記複数の現像手段の前記静電潜像に対するそれぞれの現像の割合を計測すると共に、所定枚数のシートにトナー画像が転写されたときの現像の割合の平均が所定の割合よりも低い現像手段が発生した場合、前記現像割合の低い現像手段による現像の割合の高い静電画像を形成するようにしたことを特徴とする画像形成装置。

【請求項４】　前記像担持体を露光する露光手段と、

前記トナー画像が転写されたシートの枚数をカウントするカウンタと、

前記複数の各現像手段の静電潜像に対する現像の割合をそれぞれ計測する現像率計測手段と、

前記カウンタのカウント値及び現像率計測手段の計測値に基づき、所定枚数のシートにトナー画像が転写されたときの前記現像の割合の平均が所定の割合よりも低い現像手段が発生したと判断した場合、前記現像割合の低い現像手段による現像の割合が高い静電潜像を形成するよう前記露光手段を制御する制御手段と、

を備えたことを特徴とする請求項３記載の画像形成装置。

【請求項５】　前記現像率計測手段は前記露光手段に入力される画像信号の数を計測して前記現像手段の静電潜像に対する現像の割合をそれぞれ計測するものであることを特徴とする請求項２又は４記載の画像形成装置。

【請求項６】　前記現像の割合が高い静電潜像における前記現像割合の低い現像手段による現像の割合は５０％以上であることを特徴とする請求項１乃至５のいずれかに記載の画像形成装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、電子写真方式を用いた画像形成装置に関し、特に静電潜像をトナーにより現像する現像手段の構成に関する。

【０００２】

【従来の技術】従来の電子写真方式を用いた画像形成装置においては、例えば第１の像坦持体と第２の像坦持体とを備え、画像形成の際には、まず第１の像坦持体上に可転写画像（トナー画像）を形成し、この可転写画像（トナー画像）を、一旦第２の像坦持体である中間転写体上に一次転写させた後、この中間転写体に第３の像坦持体としてのシートである転写材を接触させ、この転写材に可転写画像を２次転写させて画像（コピー・プリント）を得る構成のものがある。

【０００３】ところで、このような画像形成装置においては、第１の像坦持体上に形成される静電潜像を現像するための現像手段である現像器を備えており、この現像器としては、現像部に現像剤であるトナーを担持搬送する現像剤担持部材である現像スリーブと、この現像スリーブが現像部に担持搬送する一成分現像剤（トナー）の層厚を薄層に規制する層厚規制手段とを備えているものがある。

【０００４】ここで、このような層厚規制手段としては、現像スリーブにゴム又は金属製の弾性ブレードを当接させると共に、この弾性ブレードと現像スリーブとの当接部の間にトナーを通過させることにより、現像スリーブ上にトナーの薄層を形成し、且つ当接部での摩擦によりトナーに潜像を現像する為の摩擦電荷（トリボ）を付与させるものがある。

【０００５】そして、例えば、このような構成の現像器を備えた画像形成装置の一例であるフルカラーのプリンターや複写機等は、ユーザーのニーズの多様化により、一台で黒色を主体とするテキスト原稿からフルカラー印刷まで、様々な利用環境下に置かれている。

【０００６】
【発明が解決しようとする課題】しかしながら、このようなフルカラーのプリンターや複写機等の画像形成装置において、黒色を主体とするテキスト原稿や、特定の色のトナーのみを使用する原稿を続けて大量に印刷する場合、利用頻度の低い、即ちトナーの消費の少ない色の現像器が生じる。そして、このようなトナーの消費が少ない現像器では、現像スリーブ上のトナーはいつまでも消費されず、また毎回弾性ブレードを通過する際にトリボ付与が行われているため、トナーがチャージアップしてしまい、不良画像を発生させてしまう。
【０００７】そこで本発明はこのような現状に鑑みてなされたものであり、トナーの消費が少ない場合でも不良画像の発生を防止することのできる画像形成装置を提供することを目的とするものである。
【０００８】
【課題を解決するための手段】本発明は、像担持体を露光して像担持体上に静電潜像を形成した後、前記静電潜像を複数の色のトナーにより現像してトナー画像を形成し、この後、前記トナー画像をシートに転写するようにした画像形成装置において、前記複数の色のトナーをそれぞれ収納すると共に収納した前記トナーにより前記静電潜像を順次現像する複数の現像手段を備え、前記複数の現像手段の前記静電潜像に対するそれぞれの現像の割合を計測すると共に、前記現像の割合が所定の割合よりも低い現像手段が発生し、かつ該現像割合の低い現像手段により現像されたトナー画像が転写されたシートが所定枚数連続した場合、前記現像割合の低い現像手段による現像の割合の高い静電画像を形成するようにしたことを特徴とするものである。
【０００９】また本発明は、前記像担持体を露光する露光手段と、前記トナー画像が転写されたシートの枚数をカウントするカウンタと、前記複数の各現像手段の静電潜像に対する現像の割合をそれぞれ計測する現像率計測手段と、前記カウンタのカウント値及び現像率計測手段の計測値に基づき、前記現像割合の低い現像手段が発生し、かつ前記現像割合が低い現像手段により現像されたトナー画像が転写されたシートが所定枚数連続したと判断した場合、前記現像割合の低い現像手段による現像の割合が高い静電潜像を形成するよう前記露光手段を制御する制御手段と、を備えたことを特徴とするものである。
【００１０】また本発明は、像担持体を露光して像担持体上に静電潜像を形成した後、前記静電潜像を複数の色のトナーにより現像してトナー画像を形成し、この後、前記トナー画像をシートに転写するようにした画像形成装置において、前記複数の色のトナーをそれぞれ収納すると共に収納した前記トナーにより前記静電潜像を順次現像する複数の現像手段を備え、前記複数の現像手段の前記静電潜像に対するそれぞれの現像の割合を計測すると共に、所定枚数のシートにトナー画像が転写されたときの現像の割合の平均が所定の割合よりも低い現像手段が発生した場合、前記現像割合の低い現像手段による現像の割合の高い静電画像を形成するようにしたことを特徴とするものである。
【００１１】また本発明は、前記像担持体を露光する露光手段と、前記トナー画像が転写されたシートの枚数をカウントするカウンタと、前記複数の各現像手段の静電潜像に対する現像の割合をそれぞれ計測する現像率計測手段と、前記カウンタのカウント値及び現像率計測手段の計測値に基づき、所定枚数のシートにトナー画像が転写されたときの前記現像の割合の平均が所定の割合よりも低い現像手段が発生したと判断した場合、前記現像割合の低い現像手段による現像の割合が高い静電潜像を形成するよう前記露光手段を制御する制御手段と、を備えたことを特徴とするものである。
【００１２】また本発明は、前記現像率計測手段は前記露光手段に入力される画像信号の数を計測して前記現像手段の静電潜像に対する現像の割合をそれぞれ計測することを特徴とするものである。
【００１３】また本発明は、前記現像の割合が高い静電潜像における前記現像割合の低い現像手段による現像の割合は５０％以上であることを特徴とするものである。
【００１４】本発明のように、露光手段により像担持体を露光して像担持体上に形成された静電潜像を、複数の色のトナーをそれぞれ収納した複数の現像手段により現像する。また、カウンタによりトナー画像が転写されたシートの枚数をカウントすると共に、現像率計測手段により各現像手段の静電潜像に対する現像の割合をそれぞれ計測する。そして、制御手段は、カウンタのカウント値及び現像率計測手段の計測値に基づき、現像の割合が所定の割合よりも低い現像手段が発生し、かつこの現像割合の低い現像手段により現像されたトナー画像が転写されたシートが所定枚数連続した場合、露光手段を制御し、この現像割合の低い現像手段による静電潜像に対する現像の割合が高い静電潜像を形成するようにする。
【００１５】
【発明の実施の形態】以下、本発明の実施の形態について図面を用いて詳細に説明する。
【００１６】図１は、本発明の第１の実施の形態に係る電子写真プロセスを利用したカラー画像形成装置の画像形成部の構成を示す図である。
【００１７】同図において、１は第１の像坦持体である回転ドラム型の感光体ドラムであり、この感光体ドラム１は、矢印の方向（反時計方向）に所定の周速度（プロセススピード）を持って回転駆動されると共に、この回転過程において１次帯電ローラ２により表面を所定の極性、電位に一様に帯電処理された後、不図示の露光手段による画像露光３により目的のカラー画像の第１の色成分像（例えばイエロー成分像）に対応した静電潜像が形

成されるようになっている。

【００１８】なお、感光体ドラム１を露光する露光手段としては、カラー原稿画像の色分解・結像露光光学系、画像情報の時系列電気デジタル画素信号に対応して変調されたレーザービームを出力するレーザースキャナによる走査露光系等がある。

【００１９】また、同図において、４１、４２、４３、４４はイエロー、マゼンタ、シアン、ブラックの現像器であり、これら各現像器４１，４２，４３，４４は不図示の回転駆動装置によって図中矢印の方向に一体的に回転することにより、現像過程で感光体ドラム１と対向するように配設されている。

【００２０】ここで、これら各現像器４１，４２，４３，４４は現像剤坦持体としてそれぞれ現像スリーブ４ａを備えている。なお、この現像スリーブ４ａは感光体ドラム１と対向したときに感光体ドラム１と順方向に回転すると共に、その表面はトナーとの摺擦確率を高くし、かつトナーの搬送を良好に行うための適度な凹凸を有している。

【００２１】また、その上方位置には現像スリーブ４ａの外周面に面接触にて当接する現像ブレード４ｂが設けられ、さらに現像スリーブ４ａの回転方向上流側には現像スリーブ４ａと当接する弾性ローラ４ｃが回転可能に設けられている。なお、同図において、４ｄは現像器４１，４２，４３，４４内のトナーＹ，Ｎ，Ｃ，ＢＫを攪拌する攪拌部材である。

【００２２】また、同図において、５は矢印の時計方向に感光体ドラム１と同じ周速度をもって回転駆動されている第２の像坦持体である中間転写体であり、６はこの中間転写体５と当接している転写ローラである。そして、この中間転写体５と転写ローラ６との当接ニップに、所定のタイミングで不図示の給紙カセットからレジストローラ１１、転写前ガイド１０を通過して転写材Ｐが給送されるようになっている。

【００２３】また、２８は２次転写バイアスを転写ローラ６へ印加するバイアス電源であり、このバイアス電源２８からの２次転写バイアスにより中間転写体５上に転写された画像が転写材Ｐへ転写されるようになっている。なお、１３は感光体ドラム１表面の残トナーを除去するクリーニング装置、１５は中間転写体５から転写されたトナー画像を転写材Ｐに加熱定着させる定着器である。

【００２４】次に、このように構成された画像形成装置における画像形成動作について説明する。

【００２５】まず、感光体ドラム１の回転過程において１次帯電ローラ２により感光体ドラム１の表面を所定の極性、電位に一様に帯電処理し、この後、不図示の露光手段による画像露光３により、感光体ドラム１上に目的のカラー画像の第１の色成分像（例えばイエロー成分像）に対応した静電潜像を形成する。

【００２６】次に、この第１の色成分像に対応した静電潜像を第１現像器（イエロー現像器）４１によってイエロートナーＹにより現像し、この後、この感光体ドラム１上に形成坦持された第１色のイエロートナー画像を、感光体ドラム１と中間転写体５とのニップ部を通過する過程で、中間転写体５に印加される１次転写バイアス電源２９によって形成される電界と圧力とにより、中間転写体５の外周面に中間転写する。以後、この工程を１次転写という。

【００２７】以下、同様の１次転写により、第２色のマゼンタトナー画像、第３色のシアントナー画像、第４色のブラックトナー画像を順次中間転写体５上に重畳転写し、目的のカラー画像に対応した合成カラートナー画像を形成する。

【００２８】次に、転写材Ｐを中間転写体５と転写ローラ６との当接ニップに所定のタイミングで給送して中間転写体５に当接させると共に、転写ローラ６へ２次転写バイアスを印加することにより、中間転写体５上に重畳転写された合成カラートナー画像を転写材Ｐへ転写する。以後、この工程を２次転写という。

【００２９】そして、この２次転写の後、中間転写体５から転写材Ｐを分離して定着器１５に導入し、この定着器１５において転写されたトナー画像を転写材Ｐに加熱定着する。これにより、転写材Ｐ上にカラー画像が形成される。

【００３０】ところで、例えば黒色を主体とし赤色の文字が少しあるというようなテキスト原稿の場合、本構成の画像形成装置においては、シアン現像器４３は、現像過程で感光体ドラム１と対向すると共に現像スリーブ４ａ等が回転し、現像可能状態になるがシアントナーＣは全く使用されない状況となる。

【００３１】ここで、このような状況が連続する場合、現像スリーブ４ａ上のトナーＣはいつまでも消費されず、また毎回弾性ブレード４ｂを通過時に、トリボ付与が行われているためトナーＣがチャージアップしてしまう。そして、このようにトナーＣがチャージアップしてしまうと、シアン画像の現像時というときに、トナーＣが適正なトリボ状態に無いために不良画像が発生してしまう。

【００３２】そこで、本実施の形態においては、それぞれの現像器４１，４２，４３，４４の現像率の一例である印字率及び転写枚数である印字枚数を計測し、低印字率の画像が規定枚数以上連続した場合には強制的に高印字率の画像を印字するようにしている。なお、本発明において、この印字率は、印字されるメディアに対しての印字の割合とする。

【００３３】図２は、このような制御を行うためカラー画像形成装置に設けられたコントローラのブロック構成図であり、同図において、１１０はコントローラ、１０２は不図示の露光手段を駆動するための画像信号を出力

する画像出力部、１０４はトナー画像が転写されたシートの枚数をカウントするページカウンタ、１０１はコントローラ１１０内に設けられたドットカウンタであり、このドットカウンタ１０１は画像出力部１０２から出力される画像信号のドット数を計測するものである。

【００３４】また、１０３は制御手段であるＣＰＵであり、このＣＰＵ１０３は、現像率計測手段であるドットカウンタ１０１により計測された印字ドット数を印字率に換算した後、この印字率を記憶手段１００に各色毎（各現像器毎）に区別して書き込むと共に、この印字率と、それまで記憶手段１００に書き込まれた印字率の印字履歴とを比較するものである。

【００３５】さらに、ＣＰＵ１０３は、この印字率とページカウンタ１０４のカウント値に基づき、印字率が予め規定した所定の規定印字率Ｘ％以下の画像が連続してＹ枚印字された場合、これに該当する現像器に対し印字命令を出力し、強制的に予め設定されている高印字率のテストパターンを印字させるようにしている。

【００３６】例えば規定印字率Ｘを５％、連続印字枚数Ｙを２００枚とし、第１現像器（イエロー現像器）４１において５％以下の印字率の画像が２００枚連続印字された場合、画像出力部１０２を介して予め設定されている高印字率のテストパターンを感光体ドラム１上に形成するよう露光手段を制御すると共に、第１現像器４１に対し印字命令を出力し、強制的にテストパターン静電潜像を現像させるようにしている。

【００３７】そして、このように現像器４１，４２，４３，４４の印字率及び印字枚数を計測すると共に、低印字率の画像が規定枚数連続した場合、強制的に高印字率の画像を印字することにより、現像スリーブ４ａ上のトナーを消費させることができる。これにより、現像スリーブ４ａ上に新鮮なトナーが供給されて適正なトリボを得ることができ、不良画像の発生を防止することができる。

【００３８】なお、この高印字率のテストパターンは印字率が５０％以上のものが望ましい。また、このテストパターンは既述した画像形成プロセスを得て転写材Ｐにまで印字しても良いが、２次転写を行わずクリーニング装置１３で回収してもかまわない。

【００３９】一方、記憶手段１００としては、信号情報を書き換え可能に記憶、保持するものならば特に制限は受けないが、例えばＲＡＭや、書き換え可能なＲＯＭ等の電気的な記憶手段、磁気記録媒体や磁気バブルメモリ、光磁気メモリ等の磁気的記憶手段などが使用される。なお、本実施の形態においては、取扱い易さやコストの点から不揮発性の記憶手段であるＮＶ（Ｎｏｎ　Ｖｏｌａｔｉｌｅ）ＲＡＭを使用した。

【００４０】また、印字率を計測するドットカウンタとしては、例えばレーザーの発光時間から印字率を換算するものや、各画像のドットを形成する個々の画像信号をカウントし、印字率を換算するものなどあるが、各画像の印字率が計測できるものなら制限は受けない。

【００４１】ところで、これまでの説明においては、印字率及び印字枚数を計測し、低印字率の画像が規定枚数連続した場合、強制的に高印字率の画像を印字するものについて述べてきたが、本発明はこれに限らず、印字率及び印字枚数を計測し、規定枚数の平均印字率が規定印字率以下になった場合に強制的に高印字率の画像を印字するようにしても良い。

【００４２】図３は、このような本発明の第２の実施の形態に係るカラー画像形成装置のコントローラのブロック構成図である。なお、同図において、図２と同一符号は同一又は相当部分を示している。

【００４３】同図において、１０５はＣＰＵであり、このＣＰＵ１０５はドットカウンタ１０１により計測された画像出力部１０２より出力される画像信号のドット数を印字率に換算すると共に、この印字率を記憶手段１００に各色毎（各現像器毎）に区別されて書き込むようにしている。

【００４４】また、このＣＰＵ１０５は、記憶手段１００に書き込まれた印字率情報からそれぞれの現像器４１，４２，４３，４４の印字率の平均Ａを、予め設定されている規定枚数Ｚまで遡って計算し、予め設定してある規定印字率と常に比較すると共に、印字率平均Ａが、予め規定した規定印字率以下になった場合、その現像器において、強制的に予め設定されている高印字率のテストパターンを印字するようにしている。

【００４５】そして、このように現像器４１，４２，４３，４４の印字率及び印字枚数を計測し、規定枚数の平均印字率が規定印字率より低い値になると、強制的に高印字率の画像を印字することにより、現像スリーブ４ａ上のトナーを消費させることができる。これにより、現像スリーブ４ａ上に新鮮なトナーが供給されて適正なトリボを得ることができ、不良画像の発生を防止することができる。

【００４６】なお、この高印字率のテストパターンは印字率が５０％以上のものが望ましい。また、このテストパターンは既述した画像形成プロセスを得て、転写材Ｐにまで印字しても良いが、２次転写を行わずクリーニング装置１３で回収してもかまわない。

【００４７】

【発明の効果】以上に説明したように本発明のように、現像の割合が所定の割合よりも低い現像手段が発生し、かつこの現像割合の低い現像手段により現像されたトナー画像が転写されたシートが所定枚数連続した場合、或は規定枚数の現像割合の平均が所定の割合よりも低くなった場合、この現像割合の低い現像手段による現像の割合が高い静電潜像を形成するようにすることにより、現像スリーブ上のトナーを消費させることができる。これにより、新鮮なトナーを現像スリーブ上に供給すること

ができると共に適正なトリボを得ることができ、不良画像の発生を防止することができる。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態に係る電子写真プロセスを利用したカラー画像形成装置の画像形成部の構成を示す図。

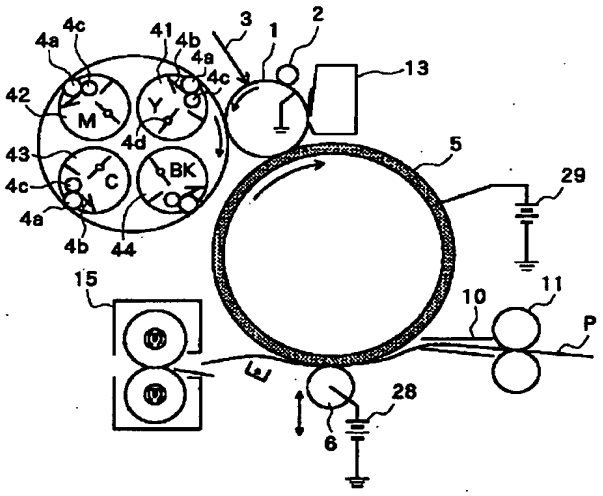
【図２】上記カラー画像形成装置のコントローラのブロック構成図。

【図３】本発明の第２の実施の形態に係る電子写真プロセスを利用したカラー画像形成装置のコントローラのブロック構成図。

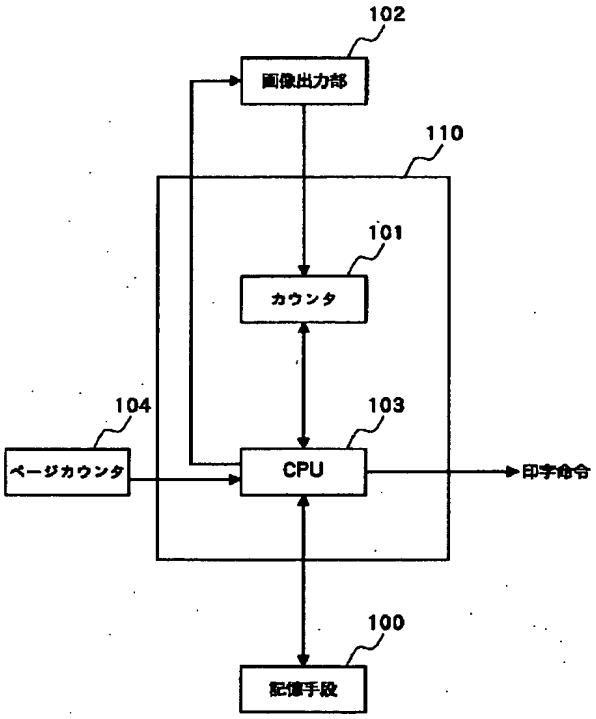
【符号の説明】

１	感光体ドラム
２	１次帯電ローラ
４１，４２，４３，４４	現像器
４ａ	現像スリーブ
４ｂ	現像ブレード
５	中間転写体
６	転写ローラ
１０１	ドットカウンタ
１０２	画像出力部
１０３	ＣＰＵ
１０４	ページカウンタ
１０５	ＣＰＵ
１１０	コントローラ
Ｐ	転写材

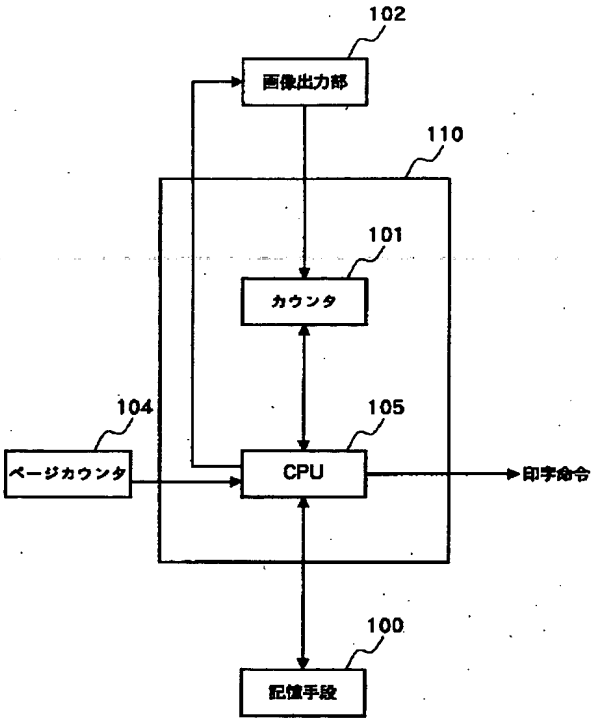
【図１】



【図２】



【図３】



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４ｄ　撹拌部材
５　中間転写体
６　転写ローラ
１５　定着器
４０，４１，４２，４３，４４　プロセスカートリッジ
４１，４２，４３，４４　現像器（現像装置）
１００　記憶手段
１０１　ドットカウンター（計測手段）
１０２　画像出力部
１０３　ＣＰＵ（算出手段）
１１０　コントローラ
Ｐ　転写材（記録媒体）
Ｙ　イエロートナー（現像剤）

Fig.1
【図１】

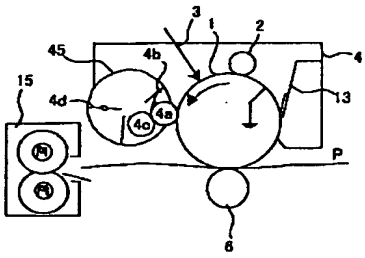


Fig.2
【図２】

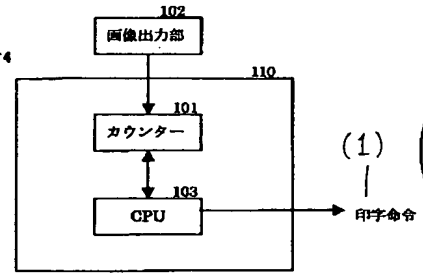


Fig.3
【図３】

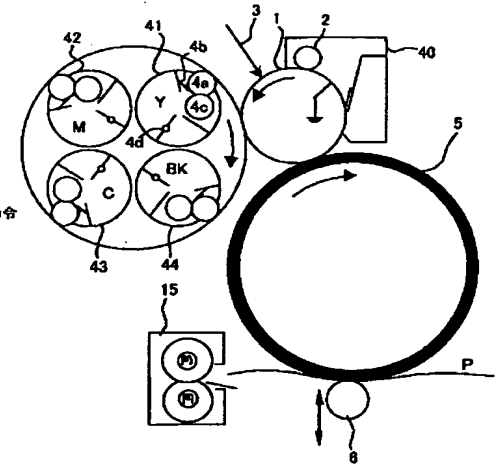


Fig.4
【図４】

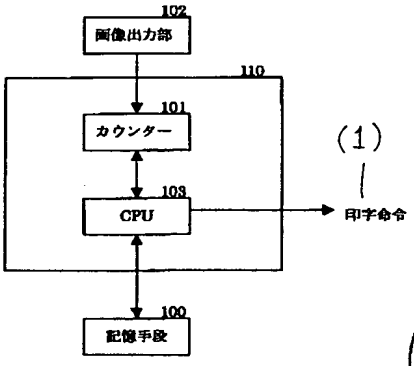


Fig.5
【図５】

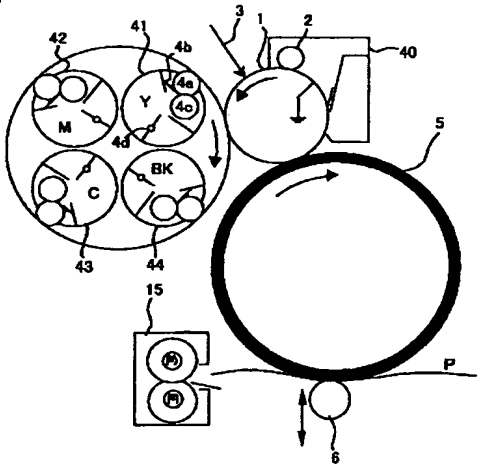


Fig.6
【図６】

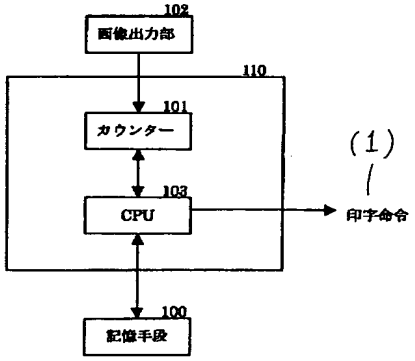
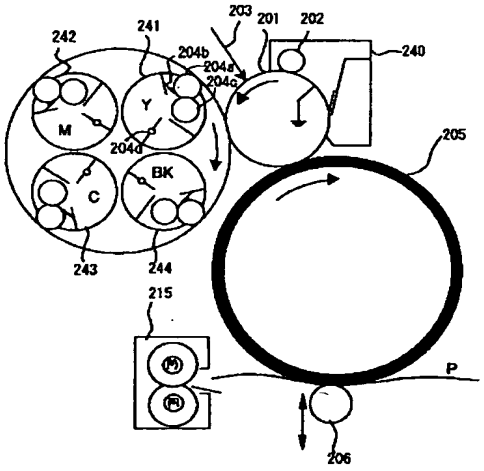


Fig.7
【図7】



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